

Localizing the Green Transition: Policy Implementation and Challenges of Renewable Energy Development in West Nusa Tenggara, Indonesia

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Abstract

This study explores the dynamics of green energy transition policy in Indonesia, with a specific focus on the Province of West Nusa Tenggara (NTB) as a pioneering region in promoting renewable energy at the local level. Against the backdrop of global energy crises and climate change, Indonesia has committed to increasing its share of renewable energy to 23% by 2025 through various national policies and regulations. At the subnational level, NTB has taken proactive steps by issuing Governor Regulation No. 13 of 2024 on Green Energy Development, as part of its broader "Green NTB" vision and the implementation of its Regional Energy General Plan (RUED). The research adopts a qualitative approach, analyzing policy documents, government reports, and relevant literature to examine how green energy policy is formulated and implemented at the local level. The findings reveal that while NTB demonstrates strong political will and regulatory frameworks, the implementation phase faces several challenges, including limited infrastructure, high investment costs, low public energy literacy, and weak institutional coordination. Moreover, green energy initiatives are often symbolic and confined to pilot projects without comprehensive long-term planning. Nevertheless, NTB's abundant renewable energy potential, commitment from local authorities, and support from national frameworks provide significant opportunities to accelerate the energy transition. The study concludes that a more adaptive, inclusive, and evidence-based policy approach is essential to overcoming implementation barriers. The NTB case offers valuable insights for other provinces aiming to develop locally contextualized strategies for sustainable energy

transformation, contributing to Indonesia's national and international climate goals.

1. Introduction

In recent decades, the global community has been confronted with two interrelated and pressing challenges: the global energy crisis and climate change (Gajdzik et al., 2024). Persistent reliance on fossil fuels has emerged as a principal contributor to greenhouse gas emissions, thereby exacerbating global warming and accelerating environmental degradation (Wang & Azam, 2024). These circumstances underscore the imperative for a fundamental transition toward a cleaner, more sustainable, and inclusive energy paradigm (Prabhakar Akhilesh, 2025). Green energy encompassing renewable sources such as solar, wind, hydro, and biomass is increasingly regarded not only as a technical solution but also as a component of a broader transformation in global energy governance (Adetomi Adewnmi et al., 2023).

As a developing nation, Indonesia faces a dual challenge: it must simultaneously address the rapidly increasing domestic energy demand driven by economic growth while also reducing carbon emissions in accordance with international obligations such as the Paris Agreement (Siregar, 2024). The Government of Indonesia has enacted a suite of strategic legislative and regulatory measures, including Law No. 30 of 2007 on Energy, Law No. 32 of 2009 on Environmental Protection and Management, and Presidential Regulation No. 112 of 2022 on the Acceleration of Renewable Energy Development (Taufik et al., 2022). Policy frameworks such as the National Energy General Plan (RUEN) and the 2020–2024 National Medium-Term Development Plan (RPJMN) underscore the strategic importance of transitioning toward a more sustainable national energy mix, with a target of 23% renewable energy contribution by 2025 (Jendral et al., 2024).

Within this regulatory landscape, subnational governments are positioned as both implementers of national policy and agents of local innovation. The Province

of West Nusa Tenggara (NTB), for instance, has demonstrated a strong commitment to the energy transition through concrete initiatives such as the articulation of its “Green NTB” vision and the promulgation of Governor Regulation No. 13 of 2024 on Green Energy Development (UI, 2025). This gubernatorial regulation aims to expedite the deployment of new and renewable energy technologies within the province and supports the broader national objective of achieving net-zero emissions. This policy initiative builds upon the foundation laid by Regional Regulation No. 3 of 2019 concerning NTB’s Regional Energy General Plan (RUED), which serves as the province’s long-term energy planning blueprint (Febriyana et al., 2024).

However, the successful implementation of green energy policies is contingent not merely upon the existence of normative frameworks. A range of substantive challenges persists across multiple dimensions, including technical constraints (such as insufficient renewable energy infrastructure), economic limitations (notably the high capital costs of investment), social barriers (including low levels of public energy literacy), and institutional weaknesses (such as inadequate intersectoral coordination) (Monica Adanma & Olurotimi, 2024). Additionally, private sector engagement remains suboptimal, and the adoption of green technologies is frequently confined to pilot projects lacking scalability and continuity (Adolph, 2024).

Some sources have expressed specific concerns. For example, the geothermal potential in West Nusa Tenggara (NTB) may not be large, but the government is making efforts to maximize its utilization to support the expansion of renewable energy in the electricity grids of Lombok and Tambora (Sumbawa). Theoretically, various types of biomass energy sources exist in West Nusa Tenggara. However, only the biomass potential from agricultural and livestock waste is considered in this report. Forest cover exists on the islands of Lombok and Sumbawa. However, since wood is also used for other purposes, it is not considered a viable fuel option in this report. Agriculture is an important sector in the province, with key crops

including corn, coconut, and rice. Therefore, only agricultural residues are calculated to estimate the biogas potential. Lastly, livestock manure is also abundantly available and can be used for biogas production (Wijaya et al., 2024).

Based on the current condition of the regional energy sector, the following renewable energy development opportunities have been identified and will be elaborated in the next sub-section: 1). Optimization of local renewable energy potential to replace diesel (PLTD) and coal (PLTU) power generation. In this context, geothermal energy holds significant potential as a baseload replacement for coal power plants. 2). Optimization of local renewable energy potential, such as solar energy, for direct use including rooftop solar power plants on government and public buildings, public street lighting, residential use, and more. 3). Transformation of the transportation sector through the development of mass transportation such as Bus Rapid Transit (BRT) and railways for tourist areas, the development of electric vehicles starting with government fleets and tourist transportation, as well as hydrogen-fueled vehicles like buses. 4). Reducing dependence on LPG and kerosene for cooking through government programs to convert LPG stoves to electric and induction stoves and/or biogas cylinder programs based on agricultural residues as an LPG alternative.

These challenges raise a critical question: to what extent can local policy commitments be operationalized effectively at the implementation level, and what are the enabling and constraining factors influencing the success of the green energy transition in NTB?. In response to these concerns, the present study seeks to identify the key drivers and barriers to the realization of a green energy transition in West Nusa Tenggara Province. It does so by critically examining the interplay between policy frameworks, on-the-ground implementation, and local contextual variables. The findings of this research are expected to contribute to the scholarly discourse on sustainable energy governance while offering practical and strategic recommendations to local stakeholders for designing more inclusive, adaptive, and evidence-based transition pathways. Moreover, the insights generated through this

study may serve as a reference for other subnational jurisdictions in Indonesia seeking to formulate or strengthen context-sensitive and impactful energy transition policies.

Despite the Province of NTB's demonstrable commitment epitomized by Governor Regulation No. 13 of 2024 the implementation of green energy policies continues to encounter significant structural, technical, and socio-political impediments. These issues highlight the necessity for a comprehensive evaluation of the policy's efficacy in promoting an inclusive, sustainable, and environmentally just energy transition.

2. Research Method

This study employs a descriptive qualitative approach to explore the prospects and challenges of implementing West Nusa Tenggara Governor Regulation No. 13 of 2024 on Green Energy Development in the province. This approach was chosen to gain an in-depth understanding of the dynamics of policy implementation at the regional level and to identify supporting and inhibiting factors in the execution of green energy transition efforts within a local context. The research focuses on policy, institutional, social, and technical aspects related to the development of renewable energy in the region.

Data collection was carried out using in-depth interviews, document analysis, and field observations. Informants were selected purposively based on specific criteria, namely having authority, experience, or relevant knowledge concerning green energy policies in West Nusa Tenggara. Key informants included officials from the Provincial Office of Energy and Mineral Resources (ESDM), representatives from the Regional Development Planning Agency (Bappeda), environmental and energy-focused non-governmental organizations (NGOs), renewable energy business actors, as well as academics and community leaders. Field observations were concentrated in areas where green energy

projects have been implemented such as communal solar power plants (PLTS), biogas, and micro-hydro systems to obtain empirical evidence on policy implementation.

The data were analyzed using content analysis and thematic analysis methods. The analysis process involved data reduction, categorization based on key themes (policy, challenges, strategies, and actors), and drawing conclusions while considering the interrelationships among thematic categories. To enhance validity and reliability, this study employed source and method triangulation and conducted member checking to ensure the accuracy of data interpretation from the perspective of the informants. Thus, the analysis results are expected to provide a comprehensive overview of the implementation of green energy policies in West Nusa Tenggara and contribute evidence-based strategic recommendations for strengthening sustainable energy transition policies at the regional level.

3. Results and Discussion

a. Prospects for the Implementation of West Nusa Tenggara Governor Regulation No. 13 of 2024

West Nusa Tenggara Governor Regulation No. 13 of 2024 normatively reflects the commitment of the provincial government to the development of green energy as part of a sustainable development strategy. This regulation does not stand alone; rather, it refers to and reinforces the direction of national policy as outlined in the National Energy General Plan (RUEN) and the National Medium-Term Development Plan (RPJMN) 2020–2024. Accordingly, the regulation plays a strategic role in aligning regional agendas with national targets in the energy transition.

Substantively, this regulation provides a clear direction for the utilization of renewable energy potential in West Nusa Tenggara, such as abundant solar energy

in arid regions, biomass from agricultural and livestock waste, and micro-hydro potential in hilly areas. These resources represent significant opportunities to increase the share of clean energy in the province's energy mix. The "Green NTB" vision further strengthens the political legitimacy of this policy, embedding it within the region's long-term development identity.

Nevertheless, in terms of implementation, the prospects for the regulation's success remain challenged by several structural and institutional issues, including:

- 1). Limited Regional Fiscal Capacity. Funding for renewable energy projects remains highly constrained due to heavy reliance on the relatively small regional budget (APBD). There is currently no financing scheme that is both flexible and sustainable enough to support green energy infrastructure at the local level.
- 2). Limited Private Sector Investment Involvement. An attractive investment climate for the private sector has yet to be established, particularly due to the absence of adequate fiscal incentives and market guarantees. As a result, the development of renewable energy is still dominated by government-led and small-scale projects.
- 3). Infrastructure and Technological Readiness. Supporting infrastructure, such as electricity grids that are not evenly distributed, and the high costs of energy conversion technologies pose significant barriers to the development of green energy projects, especially in remote areas.
- 4). Suboptimal Incentive Schemes and Partnerships. The considerable potential of renewable energy has not been fully mobilized due to the absence of derivative regulations or implementing instruments that include mechanisms for incentives, subsidies, or public-private partnership models tailored to local contexts.
- 5). Human Resource and Institutional Capacity. The limited technical and managerial capacities of local government agencies (Organisasi Perangkat Daerah/OPD) related to energy and environmental sectors also impede

effective implementation. Training, mentoring, and technology transfer are needed to ensure the consistent operationalization of the policy.

Thus, although Governor Regulation No. 13 of 2024 serves as a significant foundation for regional energy transition, its successful implementation largely depends on strong political will, inter-agency coordination, financial support, and the active engagement of the private sector and civil society. The regional government must urgently formulate more concrete operational steps, including the preparation of an implementation roadmap, provision of investment incentives, and strengthening of institutional capacities.

b. Enabling and Inhibiting Factors for the Green Energy Transition in West Nusa Tenggara (NTB)

The green energy transition in West Nusa Tenggara (NTB) is influenced by a number of supporting and inhibiting factors that interact with each other. On the one hand, the political commitment through the “Green NTB” vision, abundant renewable energy potential, regulatory support, and the involvement of local communities and external partners are the main forces in encouraging the implementation of green energy policies. However, these efforts are still faced with various structural obstacles, such as limited regional fiscal capacity, minimal infrastructure and supporting technology, low public literacy related to energy, weak cross-sector coordination, and dependence on short-term project schemes.

Thus, to realize an effective and sustainable energy transition in NTB, strategic steps are needed to strengthen institutional capacity, increase investment, and formulate more adaptive and integrated policies across sectors and actors. Supporting factors such as a clear regulatory framework, synergy between planning documents (e.g., RUED and RPJMD), and multisectoral partnerships serve as crucial assets in accelerating implementation. However, without strengthening technical and institutional capacities at the implementation level, policies risk remaining normative documents without practical impact.

c. Contribution of Regional Policy to National Green Energy Policy

The green energy policy adopted by the Provincial Government of West Nusa Tenggara (NTB), particularly through Governor Regulation No. 13 of 2024, serves not only as a local regulatory instrument but also plays a strategic role in supporting the achievement of national energy transition targets outlined in the National Energy General Plan (RUEN) and the National Medium-Term Development Plan (RPJMN) 2020–2024.

1). **Manifestation of Decentralization Spirit in Energy Policy**

This regulation reflects the practice of decentralization, providing space for local governments to take initiative in supporting the national agenda. In the context of energy transition, decentralization allows regional governments to act not just as implementers of central policies, but also as designers and drivers of locally grounded policy innovations. With the national target of achieving a 23% renewable energy mix by 2025, the active role of regions like NTB is essential. NTB, through this regulation, contributes to accelerating the transition by managing local resources (such as solar, biomass, and micro-hydro), developing supportive local policies, and creating an enabling ecosystem for green energy development.

2). **NTB as a “Green Energy Policy Laboratory” Model**

NTB has the potential to become a policy laboratory or pilot model for other regions, particularly island provinces and underdeveloped areas with similar geographical characteristics and challenges. This is based on: 1). Community-based and participatory approaches in renewable energy development 2). Utilization of local potential to reduce dependence on fossil fuels and enhance regional energy resilience 3). Innovation in alternative financing schemes, such as collaboration with NGOs, donors, and the private sector. NTB’s success in integrating policy, institutional frameworks, and local practices could serve as a blueprint for replication in other provinces facing similar challenges in energy infrastructure and financing.

3). **Contribution to Global Agendas: SDGs and the Paris Agreement**

The implementation of green energy policy in NTB also contributes indirectly

to the achievement of Sustainable Development Goals (SDGs), particularly: SDG 7: Affordable and Clean Energy, SDG 13: Climate Action, and SDG 11: Sustainable Cities and Communities. Additionally, NTB's efforts in reducing emissions through renewable energy contribute to Indonesia's commitment under the Paris Agreement, particularly in significantly cutting greenhouse gas emissions from the energy sector, one of the largest contributors.

4). Regional Policy as a Pioneer, Not Just a Complement

In the national policy context, NTB's role illustrates that regional governments are not merely complementary actors but can serve as pioneers (leading actors) in bottom-up green initiatives. Through this regulation, NTB does not wait for central directives but instead proactively demonstrates strategic and progressive local initiative. In conclusion, the contribution of green energy policy in NTB extends beyond the local scope to national and global levels. The implementation of Governor Regulation No. 13 of 2024 provides a tangible example of how regional policy can reinforce the direction of national sustainable development through adaptive, locally grounded approaches aligned with international commitments.

d. Development of Incentive Schemes and Innovative Financing

Many regions face fiscal constraints in funding renewable energy projects. Therefore, the following are necessary: 1). Fiscal incentives, such as regional tax reductions for green energy investors, fee waivers, or permit cost exemptions, 2). Non-fiscal incentives, such as streamlined permitting processes, land provision, and regulatory support, 3). Blended financing schemes, which combine regional budget funds, private CSR contributions, international donor assistance, and community-based funds (e.g., crowdfunding for small-scale power plants) and 4). Support from regional financial institutions or local SOEs, to create tailored green energy financial products, such as microcredit for solar panel installations. With this approach, local governments do not need to rely solely on national or regional budgets but can serve

as facilitators for leveraging diverse financial resources.

The global energy crisis and climate change are two interlinked and critical issues that pose significant challenges to the sustainability of the planet. The heavy reliance on fossil fuels such as coal, petroleum, and natural gas has been a primary contributor to greenhouse gas (GHG) emissions, notably carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) (Azmi et al., 2024). The energy sector accounts for over 70% of global GHG emissions, with the largest shares stemming from fossil-fuel-based electricity generation and transportation sectors.

Climate change, driven by the accumulation of GHGs, has led to a global temperature increase of approximately 1.1°C above pre-industrial levels and continues to rise (UNEP, 2020). The consequences include increased frequency and intensity of extreme weather events, rising sea levels, ecosystem degradation, and disruptions to food and water security. These impacts exacerbate social inequalities, particularly in developing countries with limited adaptive capacity (Mesriana, 2024).

Amid growing global awareness, the transition to low-carbon energy systems has become a pivotal strategy for climate change mitigation (Saleh & Hassan, 2024). Renewable energy sources such as solar, wind, hydro, biomass, and geothermal are increasingly viewed as strategic solutions that are not only environmentally sustainable but also capable of enhancing national energy security and promoting energy inclusion (Jayabal, 2024). This transformation requires a paradigm shift in energy governance, extending beyond technological innovation to include regulatory reforms, financing mechanisms, and multi-stakeholder engagement (Zaky, 2024).

Indonesia, as a country experiencing significant economic and population growth, faces a dual challenge: ensuring sufficient energy supply while fulfilling its commitment to reduce carbon emissions (Arifin et al., 2024). Indonesia's pledge under the Paris Agreement is articulated through its Nationally Determined Contribution (NDC), which targets a 29% reduction in emissions through domestic

efforts and up to 41% with international support by 2030 (Adriansyah & Lou, 2024).

The Indonesian government has enacted several policies to promote energy transition. Law No. 30 of 2007 on Energy and Law No. 32 of 2009 on Environmental Protection and Management form the legal foundation for sustainable energy governance (Setiawan et al., 2025). In addition, Presidential Regulation No. 112 of 2022 represents a critical milestone in accelerating the development of renewable energy for national electricity provision (Hessy Oktiarifadah et al., 2024).

Through strategic documents such as the National Energy General Plan (RUEN) and the Medium-Term National Development Plan (RPJMN) 2020–2024, the government has set a target of 23% renewable energy in the national energy mix by 2025. However, by 2023, the actual share remained below 15% (Ningsih, 2024). Highlighting a gap between normative policy and practical implementation particularly in relation to economic incentives, technological capacity, and inter-agency coordination.

Decentralized governance grants local governments the authority to play a strategic role in implementing green energy policies (Hessy Oktiarifadah et al., 2024). Local governments are not only implementers of national policies but also initiators of locally grounded policies tailored to specific regional needs. The Regional Energy General Plan (RUED) serves as a key instrument for green energy planning at the local level. In the province of West Nusa Tenggara (NTB), for example, Governor Regulation No. 13 of 2024 exemplifies a concrete commitment to promoting green energy based on local potentials such as solar and biomass energy (Gubernur, 2018). Nevertheless, local implementation frequently encounters challenges, including budgetary constraints, limited technical capacity, and weak institutional coordination. Energy literacy and community engagement are also critical components (Gupta & Sigdel, 2024). Without public understanding and support for renewable energy benefits, policy implementation tends to be ineffective (Fiander et al., 2024). Therefore, local governments must act as facilitators and intermediaries among the private sector, civil society, and

international funding institutions (Masuda et al., 2022).

The successful implementation of green energy policies is influenced by several enabling factors, including abundant local energy resources, supportive national policies, and strong political commitment at the local level. NTB, for instance, possesses high solar and wind energy potential, alongside regulatory support from Presidential Regulation No. 112/2022 (Institute for Essential Services Reform, 2020).

Conversely, a range of barriers remain, such as inadequate technical and financial infrastructure, limited human resource capacity, and suboptimal incentives for local entrepreneurs. Regulatory and bureaucratic challenges also persist as structural obstacles to accelerating renewable energy investment at the local level (Adelaja, 2020).

Cross-sectoral collaboration and institutional capacity-building are essential steps to address these challenges. Through collaborative approaches, local governments can enhance implementation efficiency, expedite energy transformation processes, and advance sustainable development at the regional level (Ba et al., 2024).

4. Conclusion

NTB Governor Regulation No. 13 of 2024 is a strategic and progressive step by the West Nusa Tenggara Provincial Government in supporting the green energy transition and sustainable development. This regulation reflects the region's commitment to supporting national and global targets, especially increasing the mix of renewable energy and reducing carbon emissions, as stated in the RUEN, RPJMN, and commitment to the Paris Agreement and SDGs. However, the implementation of this policy still faces various structural and institutional obstacles, including: Limited regional fiscal capacity, Lack of private sector

investment due to suboptimal incentives, Uneven energy infrastructure and technological readiness, Limited capacity of human resources and implementing institutions and Low public literacy and cross-sector coordination. Even so, the chances of success remain high because NTB has abundant potential for renewable energy sources, strong regulatory support, political commitment through the "Green NTB" vision, and support from civil society and development partners.

Therefore, to ensure that this regulation does not stop as a mere normative document, a clear implementation roadmap is needed, an innovative fiscal and non-fiscal incentive scheme, a blended financing model, strengthening technical, institutional and community participation capacity and adaptive and contextual national-regional policy synergy. So, NTB has the potential to become a model laboratory for green energy policy for other regions in Indonesia, especially island and underdeveloped provinces, by presenting a community-based approach, local resource management, and financing innovation. NTB's success can be replicated to accelerate the achievement of national energy security, reduce dependence on fossil fuels, and strengthen Indonesia's contribution to the global sustainable development agenda.

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